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METHOD OF TREATING LAUNDRY IN A WASHING DRUM

Background of the Invention:

Field of the Invention:

The invention concerns a method for treating laundry. The laundry is subjected to turbulence by introducing mechanical energy in a washing drum driven by an electric motor. The washing drum has rib-shaped entrainment members on the inside wall, disposed in parallel relationship with an axis of the washing drum.

A method of that kind is described for example in Published, Non-Prosecuted German Patent Application DE 100 54 947 A1. For that purpose, the basic starting point adopted is the known fact that the washing result is also substantially dependent on the introduction of mechanical energy into the material being washed. A specific cleaning effect is achieved more quickly if more mechanical energy is successfully caused to act on the material being washed. In that respect it is provided therein that the procedure is reversed from one direction of rotation of the drum into the opposite direction of rotation of the drive, without a temporary stoppage, so that the laundry which still bears against the inside wall of the drum and from which moisture is removed due to the effect

of centrifugal force continues to move temporarily in the previous direction of rotation due to inertia and as a result is caused to slide over the inside wall of the drum which in the meanwhile is already rotating in the opposite direction, to give a kind of washboard effect. Due to the reduction in the centrifugal forces acting thereon, the laundry drops back into a central region of the drum and into the washing solution which is present there in order to again pick up washing solution into the fabric.

Summary of the Invention:

It is accordingly an object of the invention to provide a method of treating laundry in a washing drum that overcomes the above-mentioned disadvantages of the prior art methods of this general type.

With the foregoing and other objects in view there is provided, in accordance with the invention, a method of treating laundry. The method includes subjecting the laundry to turbulence by introducing mechanical energy to the laundry disposed in a washing drum driven by a drum drive motor. The washing drum has rib-shaped entrainment members on an inside wall disposed in parallel relationship with an axis. Control of the drum drive motor is varied in dependence on an instantaneous rotary position of the rib-shaped entrainment members.

In accordance with an added mode of the invention, there is the step of evaluating, as a rotary position-dependent signal, power consumption, motor current or rotary speed of the drum drive motor, on a basis of a fluctuation therein in dependence on a topography of the wash drum loaded with the laundry.

In accordance with a further mode of the invention, there is the step of sensing an instantaneous spatial position of the rib-shaped entrainment members using indicators associated with them at the washing drum.

In accordance with another mode of the invention, there is the step of using a magnetic position sensor, an electrodynamic position sensor or an optoelectronic position sensor on a belt pulley non-rotatably connected to the washing drum or a rotor of the drum drive motor being a direct drive motor.

In accordance with an additional mode of the invention, there is the step of deriving an instantaneous spatial position of the rib-shaped entrainment members disposed in the wash drum from an incremental counter result of drum movements.

In accordance with a further added mode of the invention, there is the step of initiating an incremental sender due to

an occurrence of a fluctuation in rotary speed or torque when driving the wash drum loaded with the laundry.

In accordance with another further mode of the invention, there is the step of using torque-dependent fluctuations in the incremental sender signal sequence for rotary position-dependent initialization of the incremental sender.

In accordance with yet another mode of the invention, there are the steps of providing the incremental sender with faults which are synchronized spatially to a drum topology and in response to which the incremental sender is initialized at a star of operation, and filtering out the faults during operation by virtue of their positioning, which is then pre-known, in a counting process.

In accordance with another additional mode of the invention, there is the step of varying a rotary speed presetting of the drum drive motor in dependence on the instantaneous rotary position of the rib-shaped entrainment members.

In accordance with a concomitant mode of the invention, there is the step of varying a torque of the drum drive motor in dependence on the instantaneous rotary position of the rib-shaped entrainment members.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is described herein as embodied in a method of treating laundry in a washing drum, it is nevertheless not intended to be limited to the details described, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments.

Description of the Preferred Embodiments:

In the prior art, the influence of the rib-shaped entrainment members which are provided on the inside wall of the drum with their axis parallel to the horizontally supported drum, on the interaction between the laundry and the washing drum, is not considered in detail. In contrast the invention is based on the consideration that the continual variation in the instantaneous rotary angular positions of the entrainment members is also thought to be of an influence, which is not to be underestimated, on the aspect of introducing mechanical

energy into the laundry. On the basis thereof, the technical object of the present invention is to be able to additionally optimize that influence in treating laundry.

In accordance with the invention, superimposed on a rotary speed control, which for example is regulated in dependence on time, for the drive of the washing drum that rotates about an approximately horizontal axis, is a control parameter which fluctuates in dependence on the instantaneous position of the entrainment members. It can provide for example that, at a given angular position in the upward movement of one of its entrainment members, the drum is stopped or is switched over to the opposite direction of rotation, so that for example woolen clothing which is entrained by the rib is only pulled to and fro through the washing solution in a gentle washing action, but is not swirled around over a full revolution of the drum. Or, in the manner of leading regulation, the torque of the drive motor is increased somewhat, immediately before the potential energy of the system is increased with the laundry being lifted out of the washing solution at one of the entrainment members, in order to counteract a breakdown in terms of rotary speed of the drum in an anticipatory mode during that rising loading phase and thus to achieve drum rotation which actually remains the same, independently of the load which varies periodically with the revolving entrainment members. On the other hand, by way of that implementation of

a control parameter which is dependent on the instantaneous position of one of the entrainment members, it is also possible to produce a specific and deliberate variation in rotary speed (more specifically, in dependence on the instantaneous position of the entrainment members), for example so that, just when the entrainment member which is loaded with laundry is emerging from the washing solution in the horizontal position, the instantaneous rotary speed is always immediately increased for half a revolution of the drum and thus, under the effect of centrifugal force, the moisture has been forced as completely as possible out of the laundry when in diametrally opposite relationship it passes into the washing solution again, from the horizontal.

To detect the instantaneous entrainment member position, it is possible to have recourse to the fact that the increased power demand at the moment of lifting an entrainment member which is loaded with laundry, especially coming out of the buoyancy effect of the washing solution, leads to a significant rise in current in the motor circuit for driving the drum, which is detected by a measuring procedure and which can be evaluated as a sensor signal in respect of the attainment of a given rotational position of each of the for example three entrainment members in succession.

However, it is also possible for the spatial position of the drum topology which is determined by the rib-shaped entrainment members to be detected directly, for example by a procedure whereby at least one of the entrainment members in the drum or the drum itself or the belt pulley non-rotatably connected to the drum or the rotor of a direct-drive motor for the drum is provided with a for example magnetic, electrodynamic or optoelectronic indicator, with a sensor which is disposed fixedly with respect to the machine responding to the passage of the indicator. For that purpose the sensor is for example in the form of a reed relay or in the form of an induction circuit when a permanent magnet fixed to the drum passes the sensor position, or it is in the form of a light barrier configuration for a reflector vane or shadow vane which rotates with the drum.

If the drum is provided with an incremental sender for the rotary movement thereof (speed of rotation and direction of rotation), that is to say with a sequence of actuators which are distributed uniformly along the periphery of the drum and which act on a proximity sensor which is fixed with respect to the appliance, then specific drum topologies are associated with given counting positions of a pulse counter which is connected on the output side of the proximity sensor. If therefore, for example at the beginning of the movement, a given count value, for example the count value ZERO, is

implemented on the counter in relation to a current drum position, then the configurations of the entrainment members in the drum are associated with given counter results, in the case of three entrainment members for example the values 0, 120 and 240 at 359 incremental positions per drum revolution. Such an initial association can be automatically implemented. That is then based on the fact that, by virtue of the variable interaction between the laundry and the entrainment members which are uniformly distributed over the inside wall of the drum, with a constant feed to the drum drive motor, by virtue of the fluctuations in torque, the loading of the rotated drum leads to fluctuations in rotary speed which can be detected without any problem and which are representative of the instantaneous positions of the entrainment members; and for that reason the occurrence of such a fluctuation can be set as the initial value in respect of the counting procedure of the incremental sender. That purpose however can also be served by the finding that the equidistantly mounted incremental sender actuators, in dependence on the drum topology, periodically lead to a fall in the repetition rate of their incremental pulse sequence which is to be summed up, so that no for example tachometric rotary speed measuring unit or power-detecting torque measuring unit has to be used for zero setting of the incremental counter.

A further preferred embodiment provides that the incremental sender deliberately incorporates one or more faults (for example a track with double the pulse period duration), wherein the faults are mechanically synchronized to the drum topology, and that synchronicity is stored in the control system for the drive. The control system also stores the incremental counter conditions at which the faults occur, in order to compensate for the faults by way of software filters. When the control system starts up for the first time after the power on reset, then drum actuation takes place at a constant rotary speed/frequency in order to be able to synchronize the incremental counter to the faults.

In regard to further alternatives and advantages of the structure according to the invention and in regard to ascertaining the instantaneous position of a drum entrainment member and the influence, which is dependent thereon, on the rotary speed control system is now further described.

Accordingly therefore the rotary speed control that in accordance with the invention is dependent on the instantaneous position of the entrainment members in the rotating drum leads to a further degree of freedom in terms of introducing mechanical energy into the laundry that is being moved in the interior of the washing drum. By way of the intensity or duration of the washing operation, that affords

additional optimization of the washing result, insofar as the interaction between the washing drum and the laundry now varies over the rotation of the drum topography or the drum movement can be adapted to the instantaneous condition of interaction between the entrainment member and the laundry.

This application claims the priority under 35 U.S.C. §119, of German patent application No. 103 16 879.6, filed April 11, 2003, the entire disclosure of the prior application is herewith incorporated by reference.